NDIA SBA Conference 2001

Simulation Based Acquisition Applied To C2 Enterprise Integration & Interoperability

15 May 2001

Lt Gen Leslie Kenne

Integrity - Service - Excellence

■ **A process that enables key AFMC activities:**

- Enterprise Management

- Developmental Planning

- Capabilities/Effects Based Requirements Development

■ **An initiative within AFMC to provide program managers, engineers, testers, logisticians, and technologists with integrated simulations, information technologies and processes to:**

- Reduce cost & time developing & sustaining systems

- Support life cycle product improvement

- Enable information sharing

- Enhance product quality

A Better Product to the Warfighter – Faster!

How Should SBA Applied?

ATD/ACTD

Sensor Craft

UCAV

MMC

- ■ **Throughout Each System's Life Cycle**
  - ■ **Warfighter/Developer Collaboration—Better Requirements**
  - ■ **Improved Insight to Operational Trades—Supporting CAIV**
  - ■ **Consistent Environment for Design & Test—Reducing Risk**

- ■ **Across All Systems**
  - ■ **Real System Interfaces—Ensuring Interoperability**
  - ■ **Family of Systems Considerations—Prioritized Upgrades**

A — Concept Exploration — Component Advanced Development — ◆ Review — **Concept Devel**

B — System Integration — System Demo — ◆ Review — **System Devel**

C — LRIP — Rate Production & Deployment — ◆ Review — **Production/ Deploy Support**

IOC

BLOCK II
BLOCK III

Continuous communication with users

Early & continuous testing

MNS — ORD — Proc/Ops & Maint

REQUIREMENTS

SBR

MT3C

MC2A

JSF

Global Hawk

MP RTIP

AOC

JSTARS

F15E

U2

AWACS

RJ

CONOPS/Requirements

System Design/Integration

DT/OT

P3I Upgrades-Sustainment

Why SBA?

Enabling
Enterprise
Management

Processes

Architecture Tools

JSB

AFMC SBA
Roadmap

Conclusion

Complex
Integrated Avionics

SWITCH-BASED NETWORK

INTEG CORE PROCESSING

MIRFS

ESM

RF Support Electronics

CNI

EO Support Electronics

Growth

Imaging, Tgt Track, Warning, CM

Stores Management System

Vehicle Management System

Inertial Reference Unit
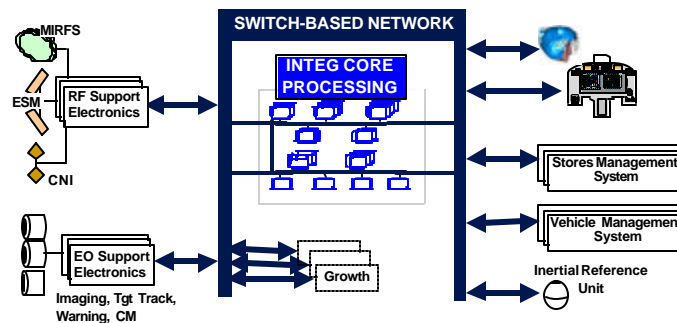
Several Million Lines of Code
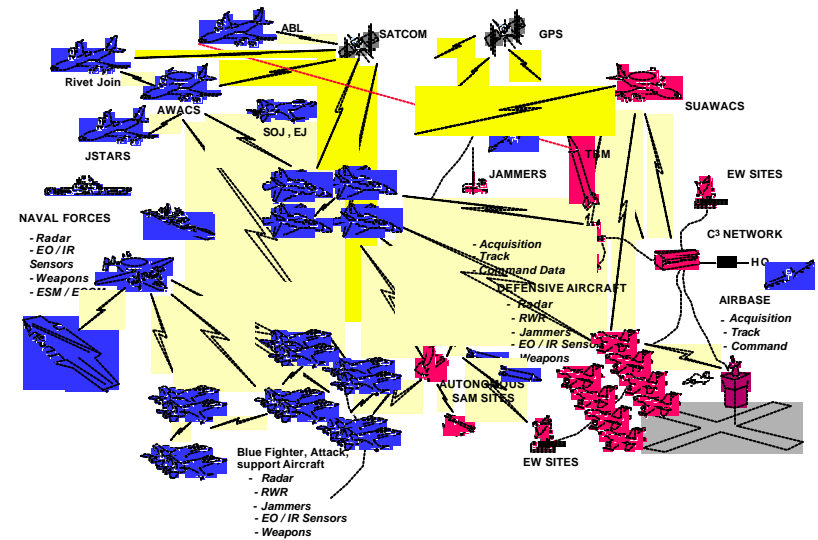
Multi-Spectral
Information Battlespace

ABL SATCOM GPS

Rivet Join

AWACS

SUAWACS

SOJ , EJ

JSTARS

TBM

JAMMERS

EW SITES

NAVAL FORCES
- Radar
- EO / IR Sensors
- Weapons
- ESM / ECCM

C³ NETWORK

- Acquisition
- Track
- Command Data

HQ

DEFENSIVE AIRCRAFT
- Radar
- RWR
- Jammers
- EO / IR Sensors
- Weapons

AIRBASE
- Acquisition
- Track
- Command

AUTONOMOUS SAM SITES

Blue Fighter, Attack, support Aircraft
- Radar
- RWR
- Jammers
- EO / IR Sensors
- Weapons

EW SITES

Greater Weapon System & Battlespace Complexity Requires A Re-Engineered Acquisition and Sustainment System to Deliver Integrated Family of Systems Solutions to the Warfighter

Interoperability Role of ESC

- *"To ensure C2ISR integration & <u>interoperability</u> issues are effectively addressed, the Electronic Systems Center (ESC) is assigned the lead role and authority for integration of Air Force C2ISR systems. ESC/CC, as the DAC for C2 Enterprise Integration, will direct actions to ensure the integration of C2ISR systems, and <u>to assure their interoperability with Joint and international systems</u>."*

- *"<u>ESC will also lead C2 Enterprise Integration planning</u> and identification of required resources <u>to ensure all USAF C2ISR systems are integrated and interoperable</u> within the USAF and DoD C2ISR framework."*

  Lawrence J. Delaney, Asst Secretary of the Air Force (Acquisition), 6 Feb 01

  - **Enterprise system architecture definition**
  - **Enterprise system configuration management & control**
  - **Enterprise performance certification**
  - **C2 Enterprise Infrastructure Acquisition**

Evolving Our Culture to Achieve Enterprise Integration & Interoperability
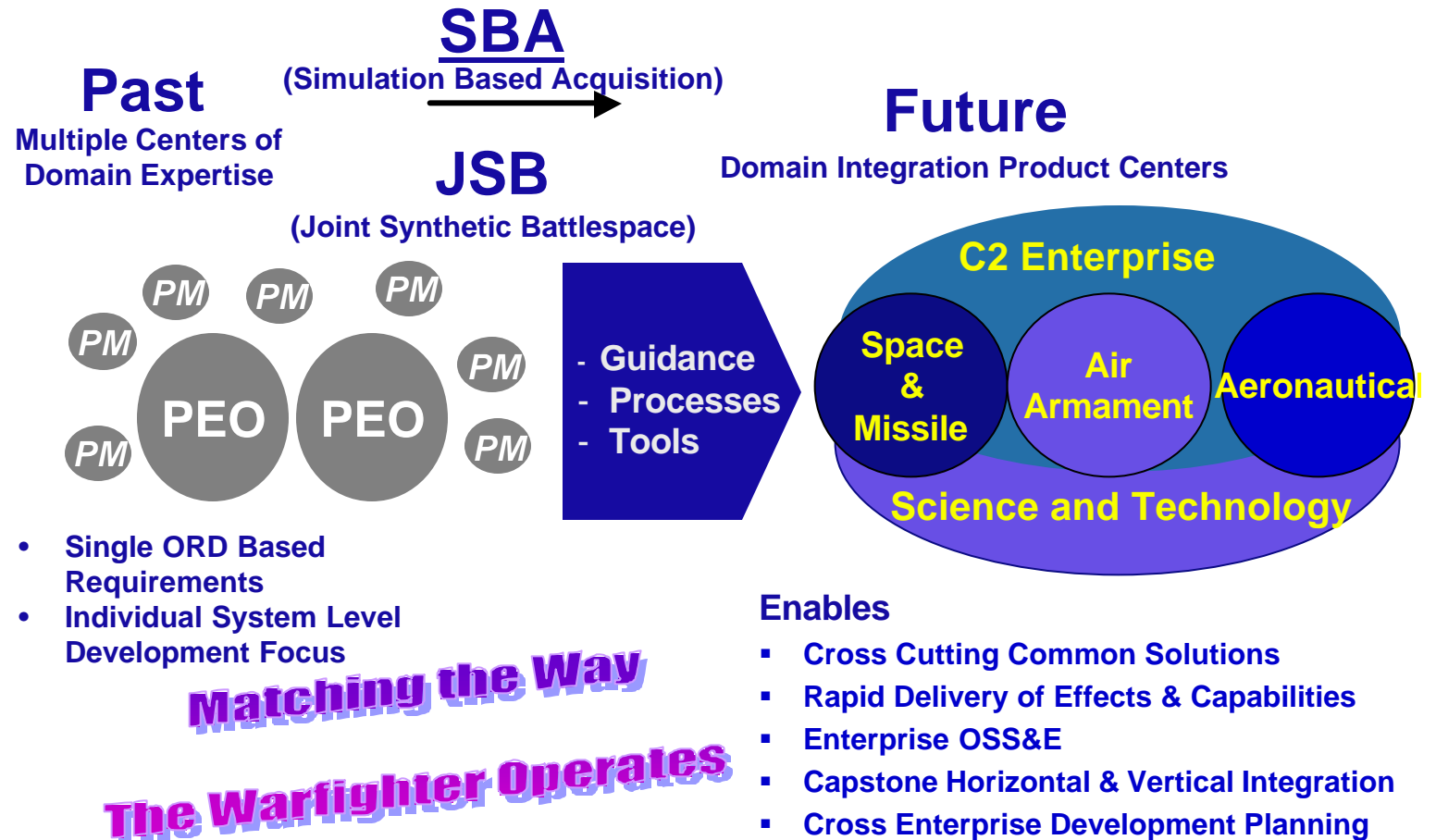
SBA
(Simulation Based Acquisition)

Past
Multiple Centers of Domain Expertise

JSB
(Joint Synthetic Battlespace)

Future
Domain Integration Product Centers

PM PM PM

PM

PM

PEO PEO

PM

PM

- Guidance
- Processes
- Tools

C2 Enterprise

Space & Missile

Air Armament

Aeronautical

Science and Technology

- Single ORD Based Requirements
- Individual System Level Development Focus

Matching the Way The Warfighter Operates

Enables

- Cross Cutting Common Solutions
- Rapid Delivery of Effects & Capabilities
- Enterprise OSS&E
- Capstone Horizontal & Vertical Integration
- Cross Enterprise Development Planning

AFMC Mandate -- To Institute the Process and Acquire the Common Infrastructure to Facilitate Domain and Cross Domain Integration of Systems ACTIVE IMPLEMENTAION OF SBA IS KEY!
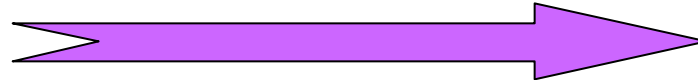
TODAY ⟶ FUTURE

Focus:
Data Processing

Focus: Operational Art

Operational Architecture Warfighter View
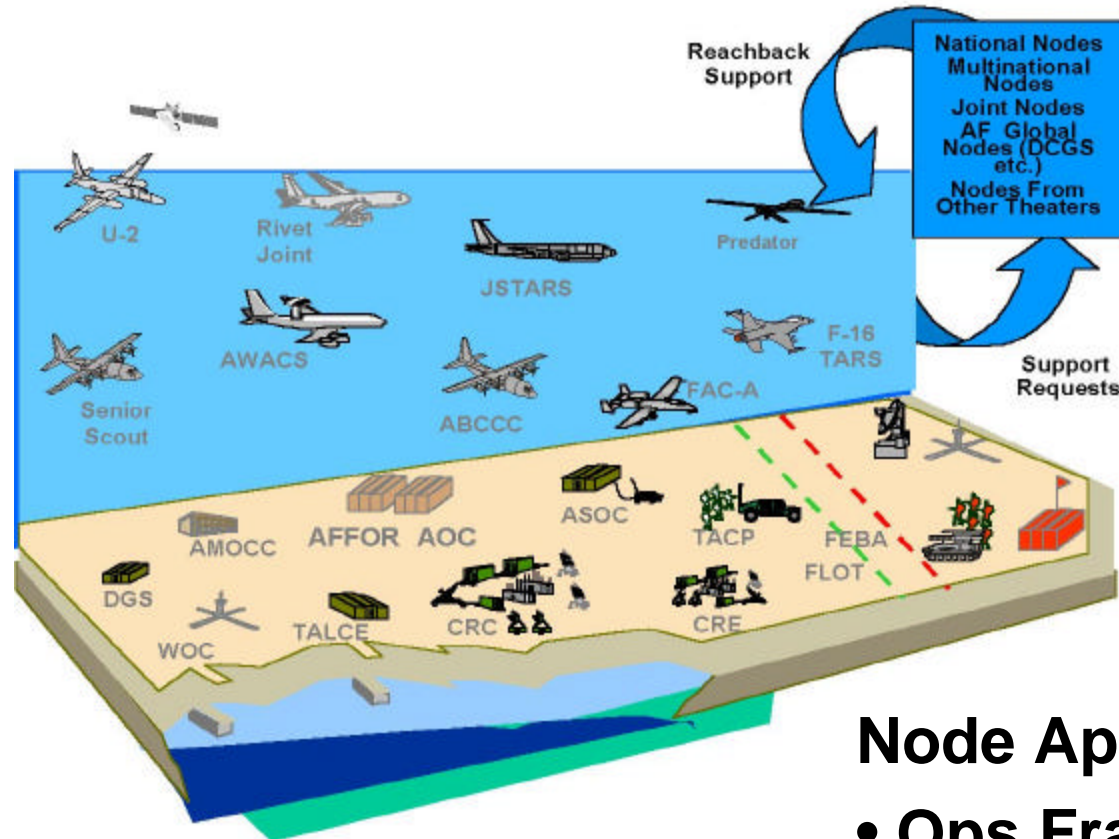
Node Approach:
- **Ops Framework**
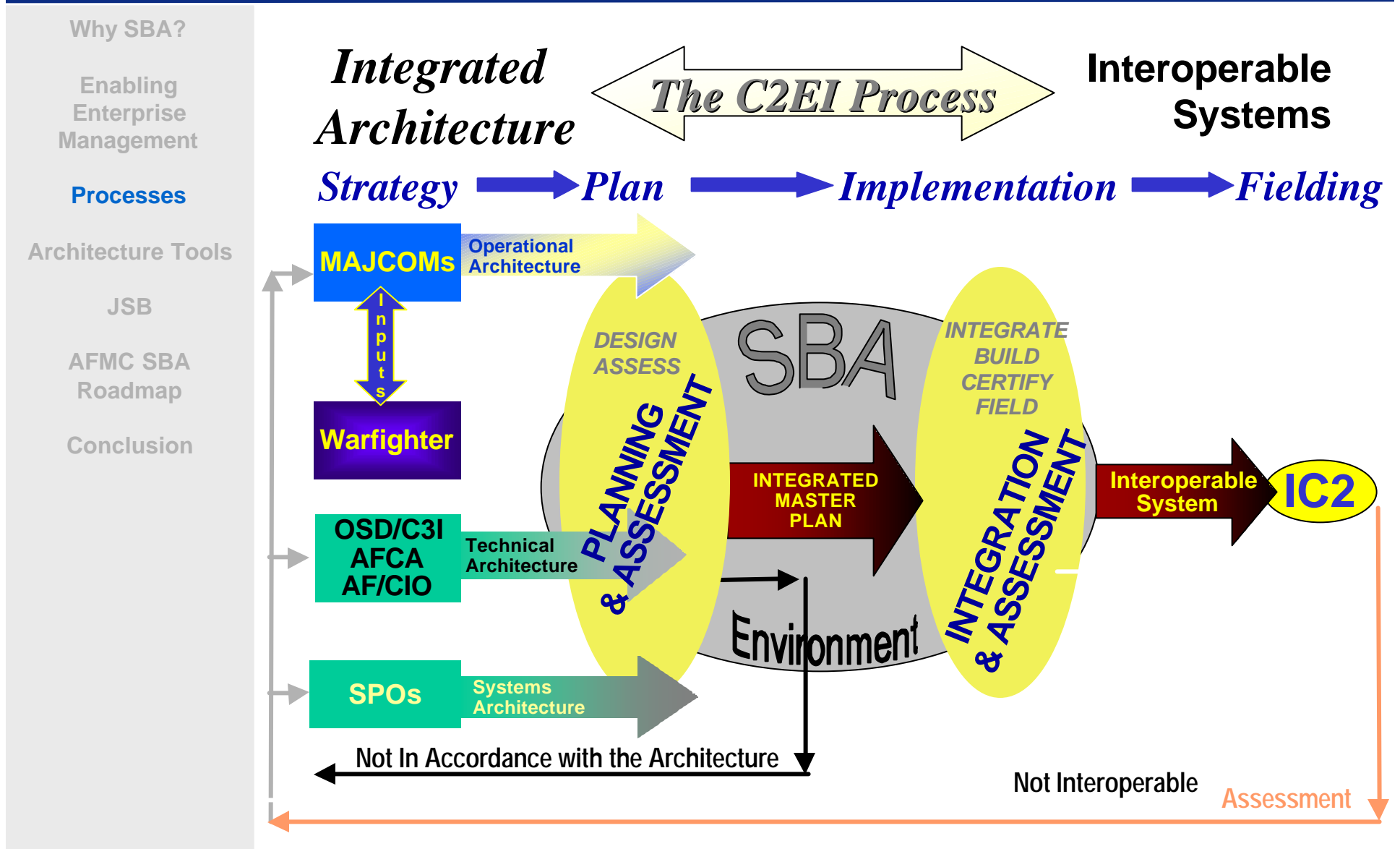- **Single Manager**
- **Capability Based**

Manage the C2 Enterprise through the nodes.

• **Each SPO is responsible for managing their node--AWACS, JSTARS, AOC, etc..**
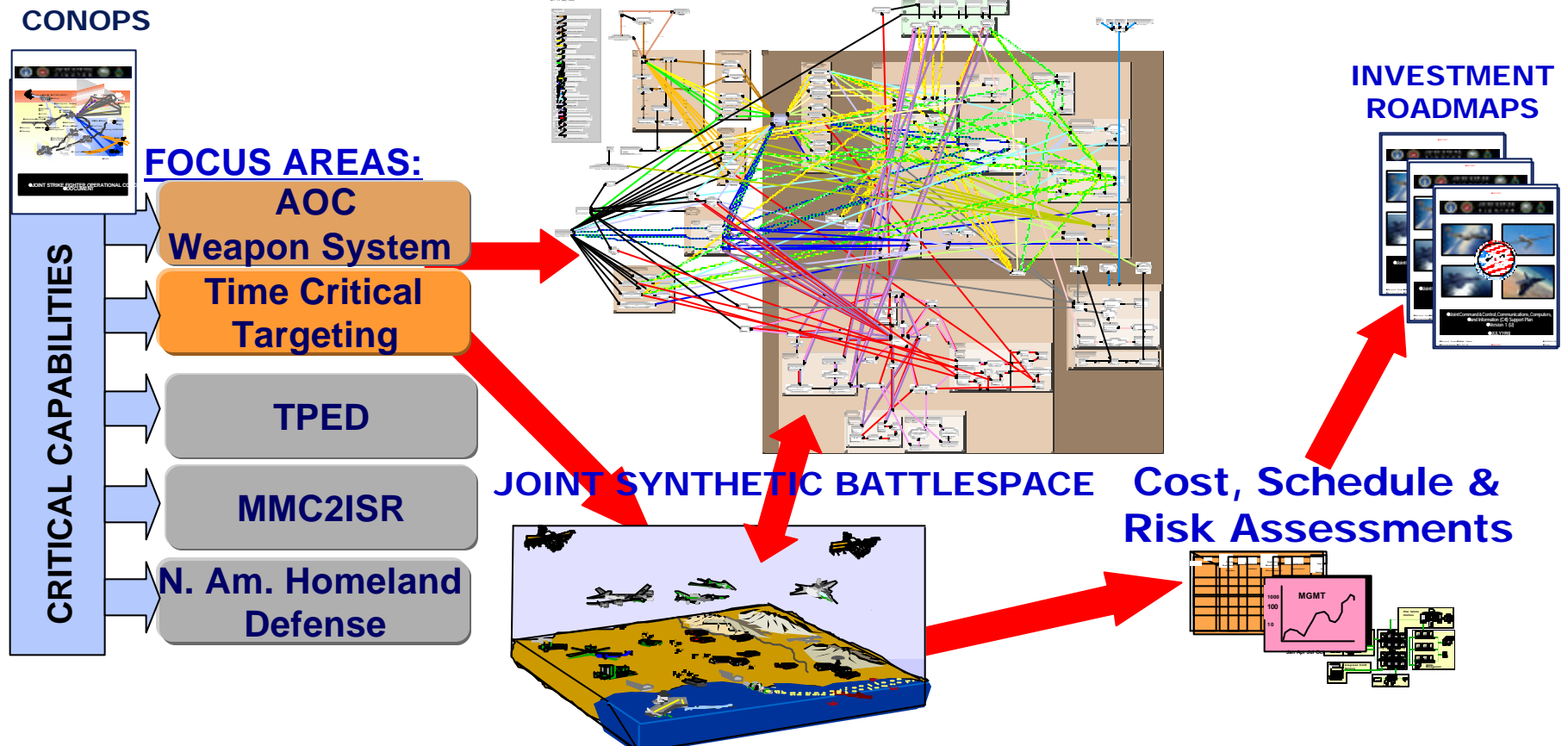• **Integrated Command & Control SPO manages node integration for interoperability.**

C2 Enterprise Integration Process

Integrated Architecture ⇦ **The C2EI Process** ⇨ **Interoperable Systems**

Strategy → *Plan* → *Implementation* → *Fielding*

MAJCOMs

Operational Architecture

Inputs

Warfighter

OSD/C3I AFCA AF/CIO

Technical Architecture

SPOs

Systems Architecture

DESIGN ASSESS

PLANNING & ASSESSMENT

SBA

INTEGRATED MASTER PLAN

Environment

INTEGRATE BUILD CERTIFY FIELD

INTEGRATION & ASSESSMENT

Interoperable System

IC2

Not In Accordance with the Architecture

Not Interoperable

Assessment

C2 Enterprise Assessment Process— Analysis of Roadmap Alternatives

INTEGRATED OPERATIONAL & SYSTEM ARCHITECTURE VIEWS

CONOPS

INVESTMENT ROADMAPS

CRITICAL CAPABILITIES

FOCUS AREAS:

AOC Weapon System

Time Critical Targeting

TPED

MMC2ISR

N. Am. Homeland Defense

JOINT SYNTHETIC BATTLESPACE

Cost, Schedule & Risk Assessments

Tracking Critical Capability "Threads" thru Focus Areas: Assessing Technical Architecture Implications, Addressing Family of Systems Interoperability thru Warfighter-in-the-Loop Synthetic Battlespace Experiments, Assessing Cost-Risk-Schedule of Alternatives and Transforming this Information into Recommended Materiel Solution Roadmaps

Physical Model of C2 Facility

Why SBA?

Enabling
Enterprise
Management

Processes

Architecture Tools

JSB

AFMC SBA
Roadmap

Conclusion

Identifying "User Positions By Cell" Using AOC Integrated Data Base

The MITRE Corporation

Cells

NIST	JIC
FP	CurOps
PLANS	PM

Close

Retrieval of Equipment Configuration Using AOC Integrated Data Base
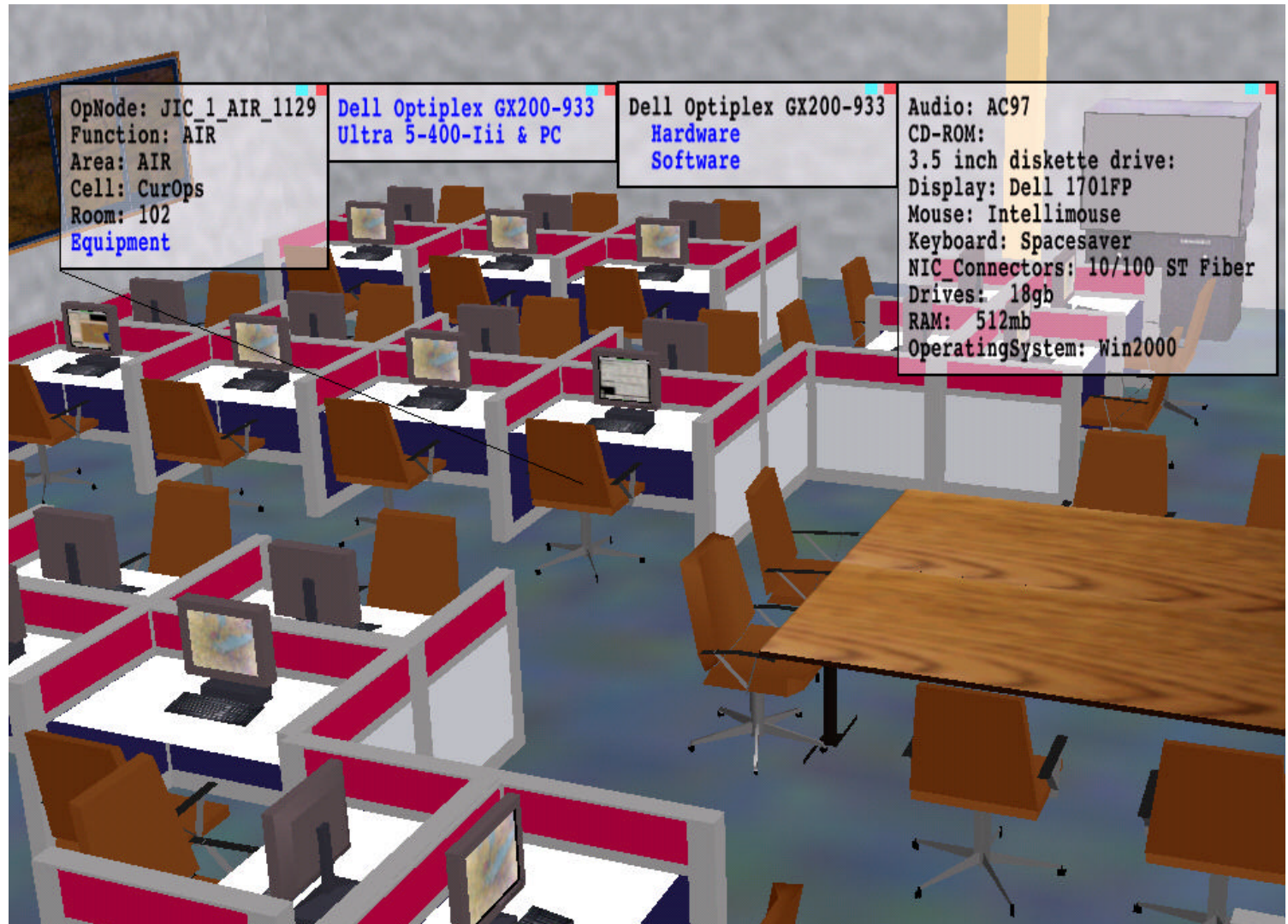
INDIVIDUAL WORKSTATION MODEL

UserPos

Operational Activities

Human Resource
ULN

Data Entity
TBD

Manual
Activities

Data Entity
TBD

Automated
Activities
TBD

SW

Data Entity
TBD

Automated
Activities
TBD

SW

Data Entity
TBD

Strategy Division—Joint Air Operations Plan Operational Thread
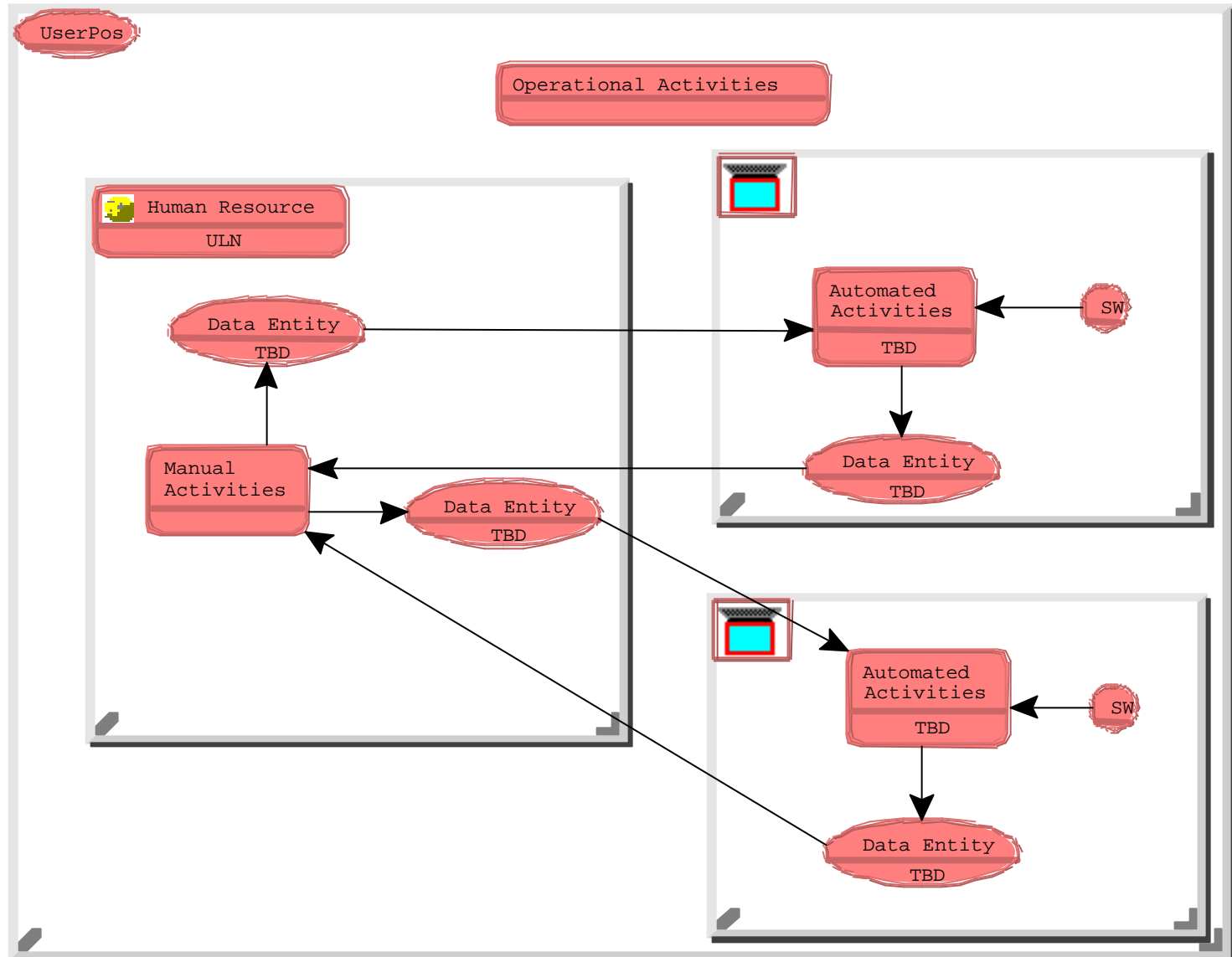
Integrated Operational/System Architecture View of the AOC
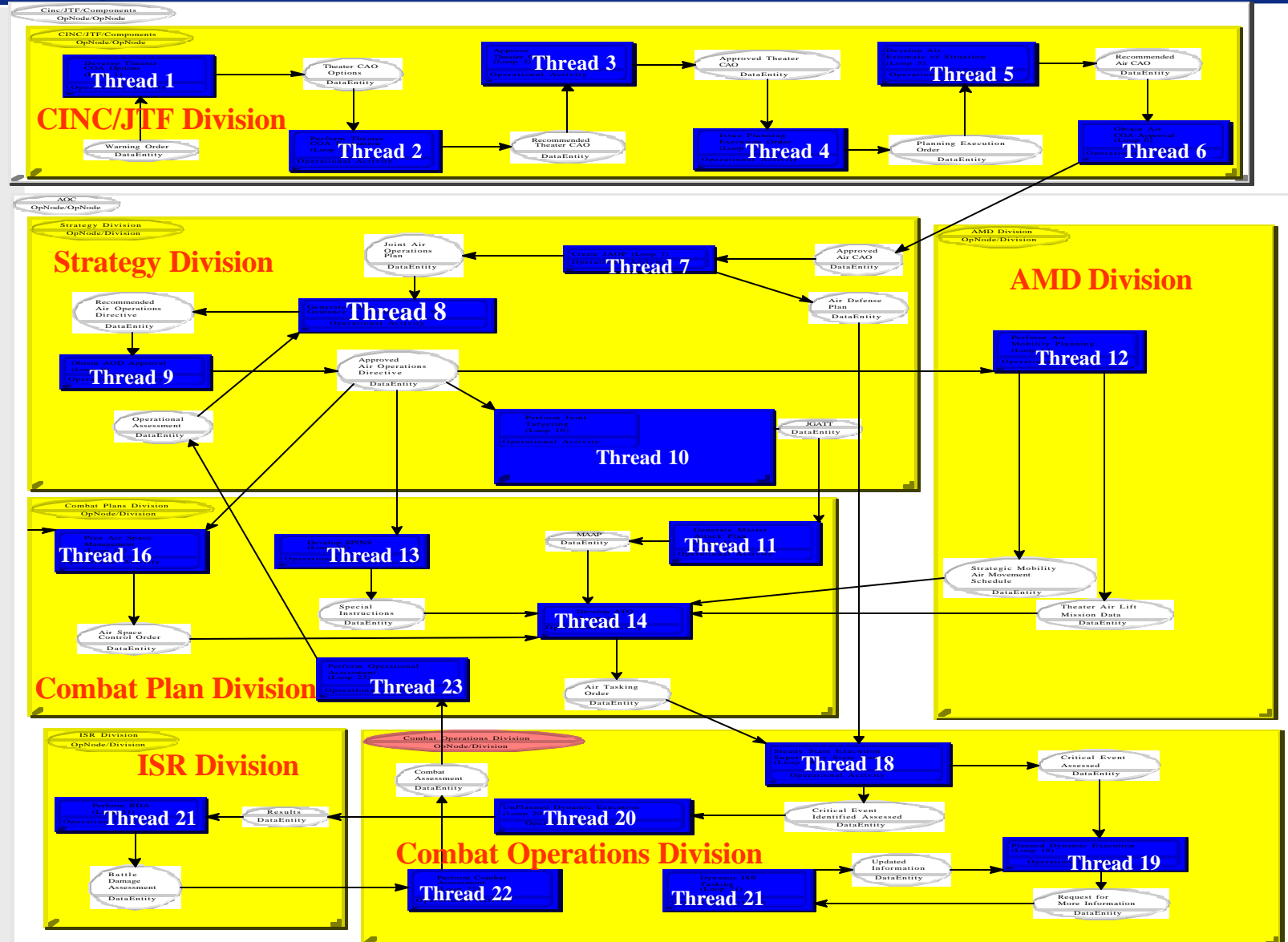
Integrated Architecture Tools Can Become a Living C4ISP

- **Today:**
  - **An Acquisition <u>document</u> by the PM**

  - **C4ISP comprised of C4I support requirements, shortfalls, and solutions**

  - **The bulk of the C4ISP information is provided via IERs, <u>Architectures</u> and the System Security Authorization Agreement**

- **Tomorrow:**
  - **<u>Integrated Architecture Tool</u> applications are a unique type of modeling that can become the essence of a C4ISP**

  - **Common Data Schema will allow pervasive interoperability assessments by engineers using these tools**

  - **Ensures interoperability "up front" during design—specified to any level of interface—even down to software code**

Joint Synthetic Battlespace
A Key Element of SBA

Multiple Platforms & Data Links

C2ISR

Visual Recording Displays & Playback

Synthetic Battlespace JSB

Advanced Weapons

Validated Threats/Scenarios

Distributed Network

Warfighter in the Loop
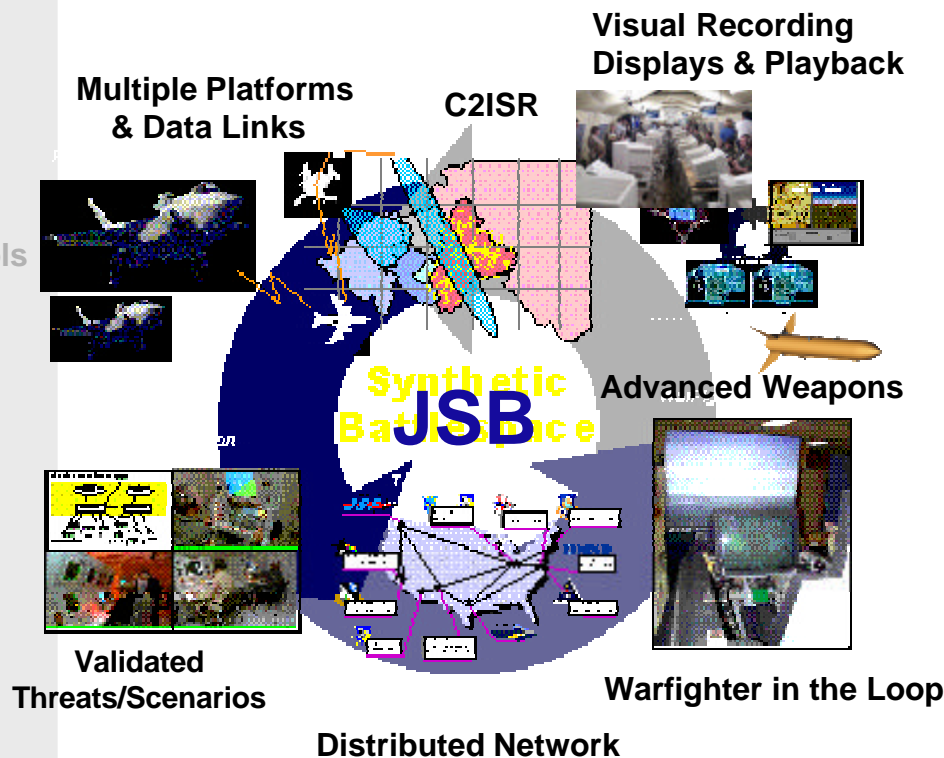
WHY?
Tactical and Analytical Realism

- **WarFighter/Developer Collaboration**

- **Real System Interfaces (HWIL/SWIL)**

- **Improved Insight to Operational Trades**

- **Demonstrate Large Scale Exercises**

- **Interoperability Testing**

- **Family of Systems approach to   System Effectiveness**

- **True Industry/Government Partnership**

Levels Playing Field Across the Industry-Government Enterprise

Joint Synthetic Battlespace
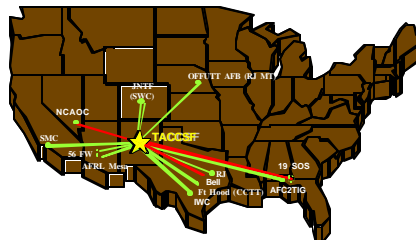## *Enabling Tool for System Acquisition*

- **Immerses the Warfighter into the Acquisition Process**
  - **Quicker Fielding – Avoid Redesign/Mistakes**
  - **Cost Avoidance – Total Systems Savings**
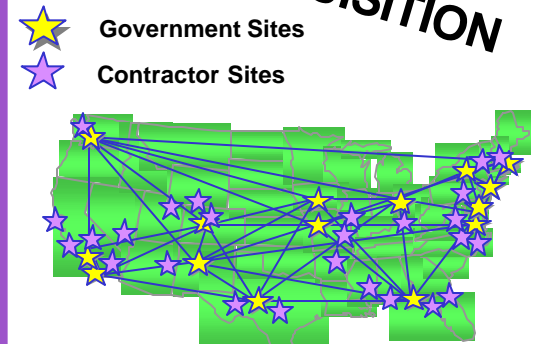 - **Improved Product – Better Design/Operator Interfaces**

WARFIGHTER

Joint Synthetic Battlespace

ACQUISITION

Government Sites
Contractor Sites

- **Training**
- **Mission Rehearsal**
- **Operations Definition**

- **Repeatable**
- **Variable Resolution/Fidelity**
- **Verified/Validated/Trusted**
- **Distributed or Standalone**
- **"Corporate" Infrastructure**

- **Technology Analysis**
- **Design Trades**
- **Systems Engineering**
- **Integration and Test**
- **Operational Testing**

Leveraging Strategic Partnerships to Establish the Synthetic Environment

Working with:

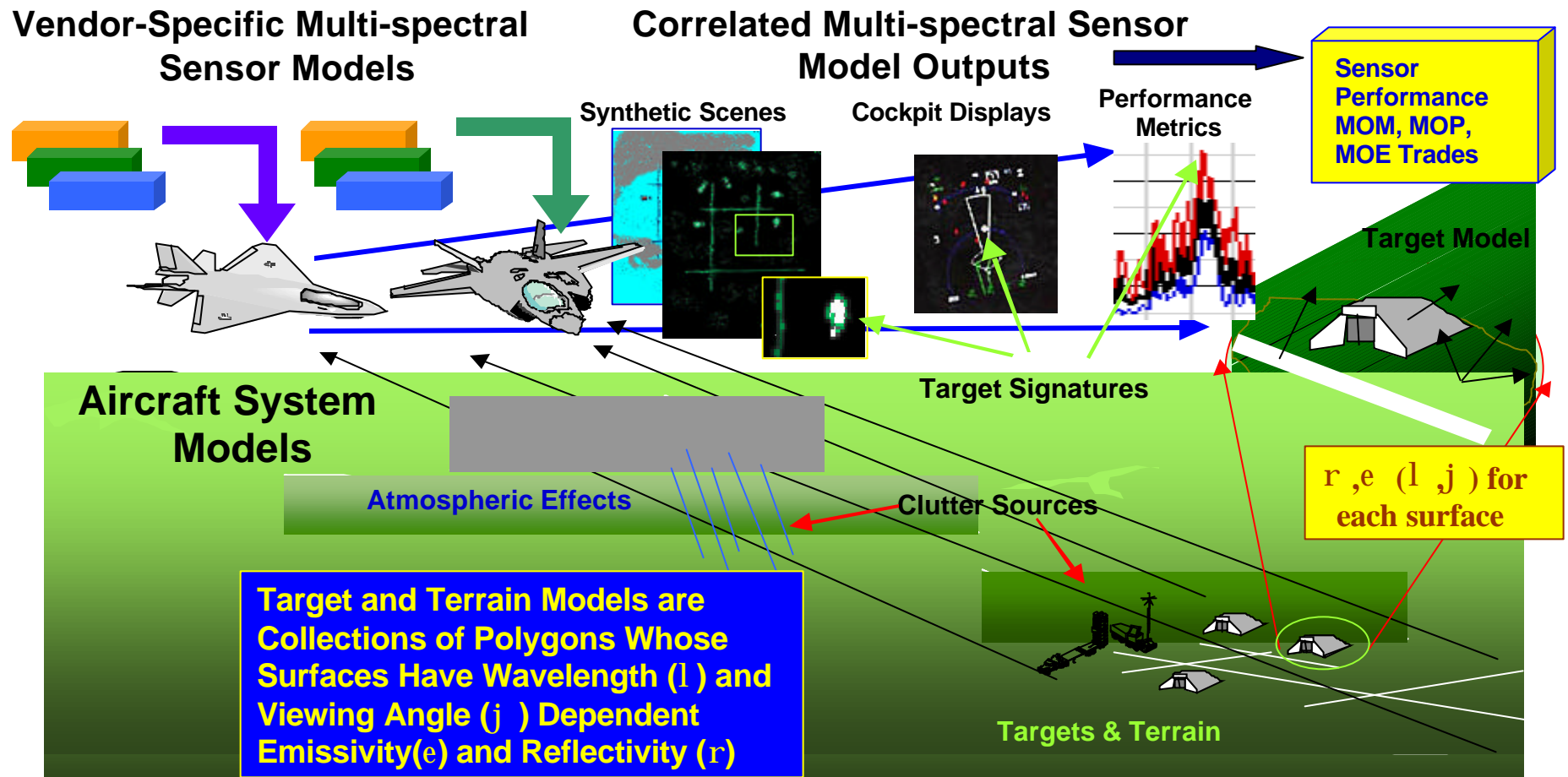- JC2ISR JT&E
- JCIET
- Target Under Trees (TUT) PM
- Global Hawk Upgrades
- Sensor Craft
- MP RTIP
- MT3C Study
- MC2A Constellation Study
- AC2ISRC-TACCSF
- AFSPACECOM
- AAC, ASC, ESC, SMC, AFFTC, AFRL Wide
- XOC-AFAMS
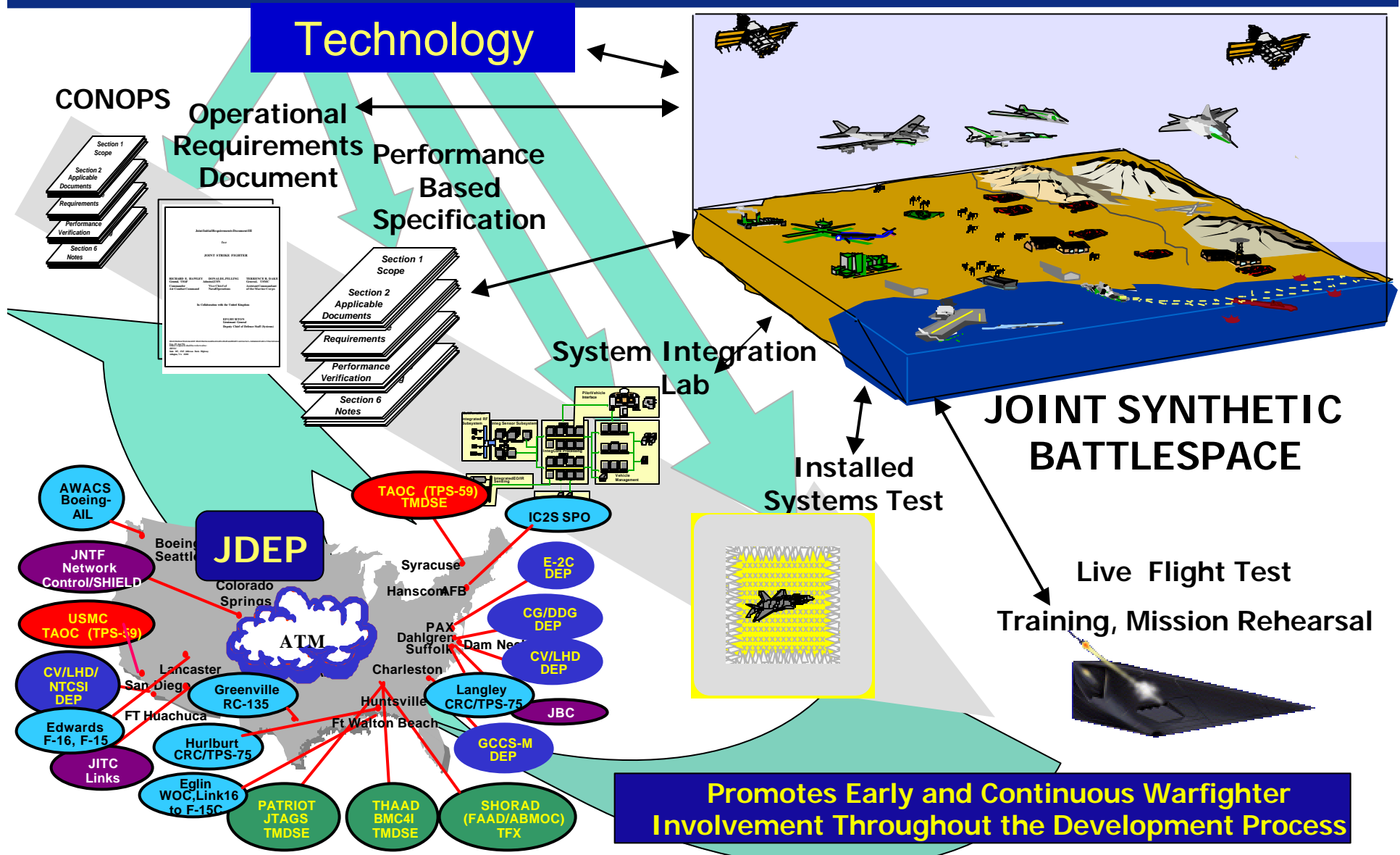- DARPA, Dept of the Army, RDEC Federation, JPSD, ACS, FCS…

Contributes to Timeline Reductions

Use Common Metrics, Scenarios and Environment to Analyze Family of Systems
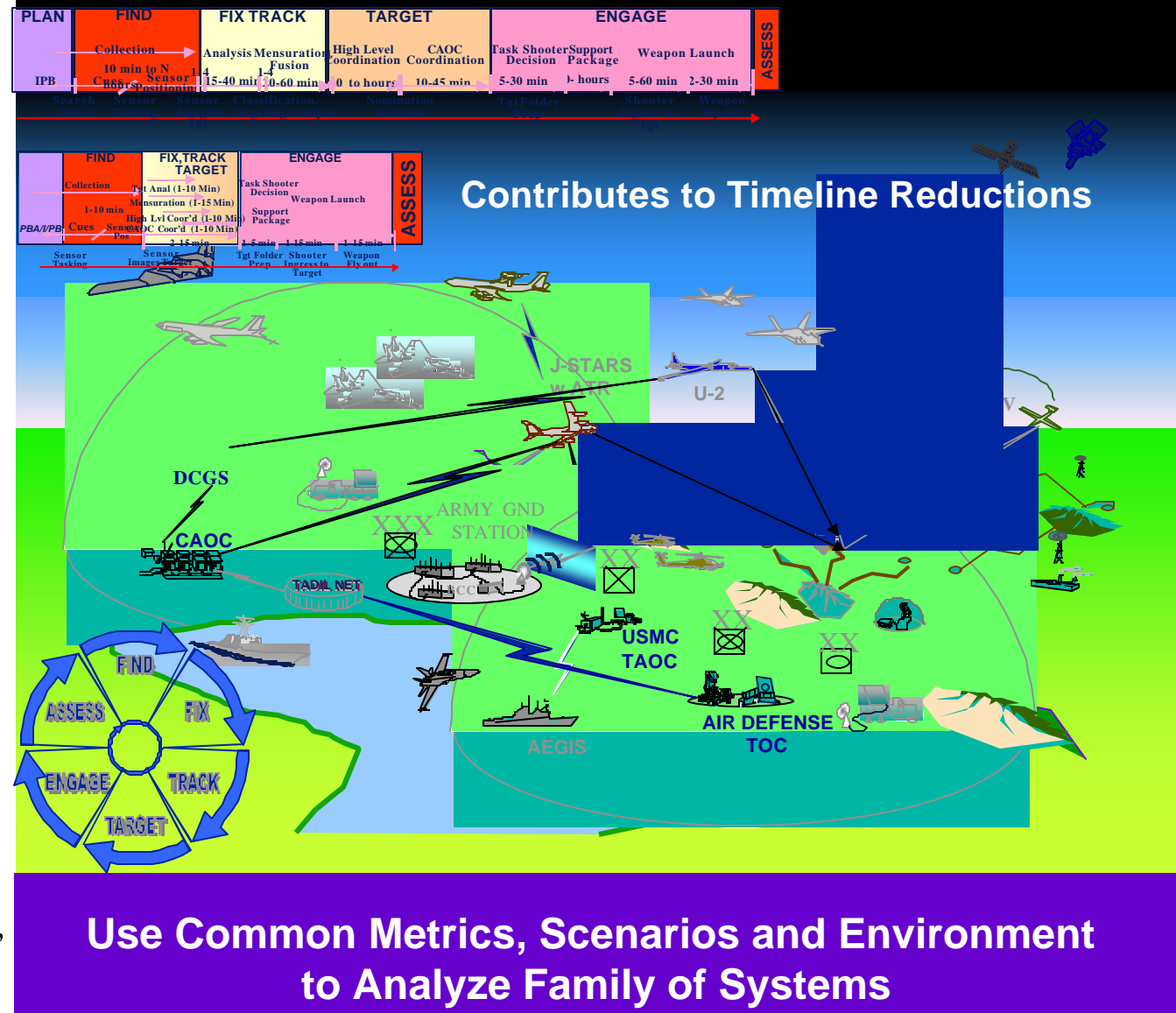
Need Robust Synthetic Environment
(e.g., Multispectral Sensor Analysis)

Vendor-Specific Multi-spectral Sensor Models

Correlated Multi-spectral Sensor Model Outputs

Synthetic Scenes

Cockpit Displays

Performance Metrics

Sensor Performance MOM, MOP, MOE Trades

Target Model

Target Signatures

Aircraft System Models

$r, e \, (l \, j) \, for$ each surface

Atmospheric Effects

Clutter Sources

Target and Terrain Models are Collections of Polygons Whose Surfaces Have Wavelength (l) and Viewing Angle (j) Dependent Emissivity(e) and Reflectivity (r)

Targets & Terrain

Synthetic Environment At-sensor Radiance/Reflectance a Function of Wavelength, Terrain/Atmosphere Geophysics, Target Physics, Season, ...

SBA and JSB Support To The Acquisition & Sustainment Lifecycle

Technology

CONOPS

Operational Requirements Document

Performance Based Specification

Section 1 Scope
Section 2 Applicable Documents
Requirements
Performance Verification
Section 6 Notes

System Integration Lab

JOINT SYNTHETIC BATTLESPACE

Installed Systems Test

Live Flight Test

Training, Mission Rehearsal

JDEP

AWACS Boeing-AIL

JNTF Network Control/SHIELD

USMC TAOC (TPS-59)

CV/LHD/ NTCSI DEP

Edwards F-16, F-15

JITC Links

Boeing Seattle

Colorado Springs

ATM

Lancaster
San Diego

FT Huachuca

Greenville RC-135

Hurlburt CRC/TPS-75

Eglin WOC,Link16 to F-15C

Syracuse

Hanscom AFB

PAX Dahlgren
Suffolk

Charleston

Huntsville

Ft Walton Beach

Dam Neck

TAOC (TPS-59) TMDSE

IC2S SPO

E-2C DEP

CG/DDG DEP

CV/LHD DEP

Langley CRC/TPS-75

JBC

GCCS-M DEP

PATRIOT JTAGS TMDSE

THAAD BMC4I TMDSE

SHORAD (FAAD/ABMOC) TFX

Promotes Early and Continuous Warfighter Involvement Throughout the Development Process

Impact of Developing Synthetic Battlespace

- **Enables Disciplined Systems Engineering & Testing up to the Joint and Coalition Force Level**
  - Tied to OSD Initiatives (e.g., JDEP, NATO C3 Agency)
  - Joint Partnership (e.g., Army - Joint Virtual Battlespace)
- **Provides Repeatable "Controlled Environment" for Evaluating Joint Force-level Interoperability**
  - Reveals "Why" vice Replicating Interoperability Problems or Capturing Effects
- **Expands Ability to Conduct System-level Interoperability "Fault Isolation"**
  - Controlled Environment to Evaluate "Workarounds" and "Fixes"
- **Enables Validation of Joint Force Operational Tactics, Techniques, and Procedures Prior to Deployment**

Systems Engineered Approach Enables Virtual Integration of Global Strike Task Force

AFMC FY 01 SBA Infrastructure Investment Plan

Air to Ground Synthetic Environment
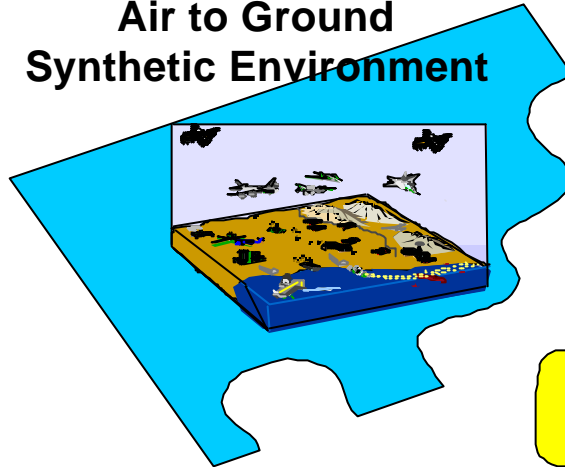
AOC Weapon System Executable Architecture
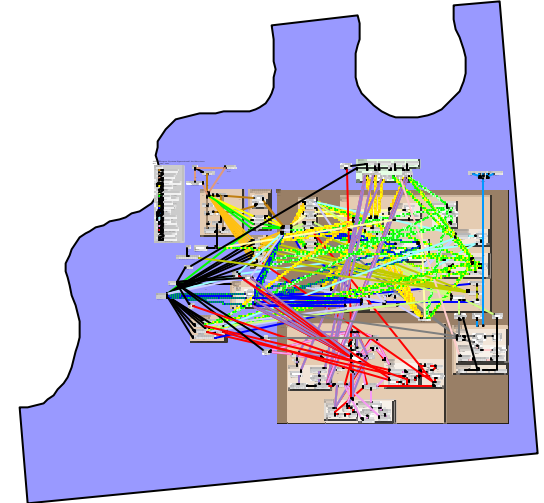
Network Bandwidth Management

CEE

Comm Tools
M&S Tools
Virtual Testbed
Domain Specific Tools
Common Databases
DIF & DIRR

Collaboration
HLA
CORBA
JTA/DII
DCO
MJava
XML
HTTP
RMI

Standards Based Enterprise Collaborative Framework

Services

Product Centers
Test Centers
Logistics Centers
MAJCOMs
Battle Labs
University & Industry
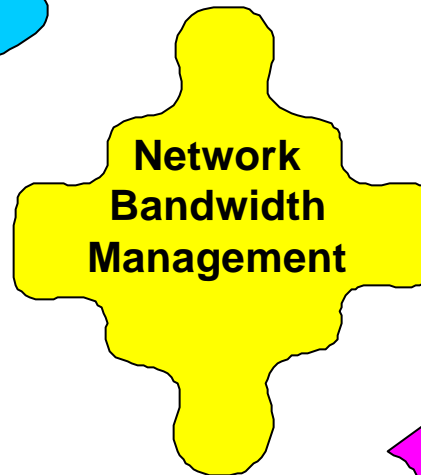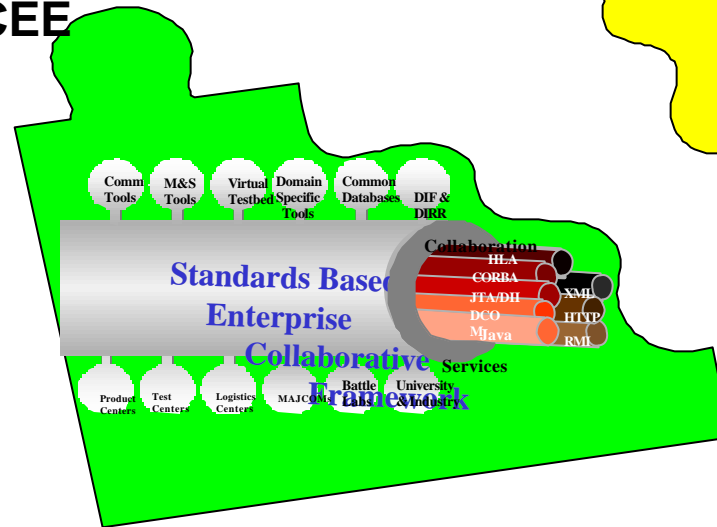
Simulation Networks

Summary

- **AFMC in <u>Partnership with Industry and the Warfighter</u> is Moving Forward to Develop a SBA/JSB Capability That Addresses the System Acquisition Challenges of Integration and Interoperability**
  - An Architecture driven Systems Engineering process
  - Synthetic Environment Fidelity to Support Systems Engineering—User and Tester validated
  - Level Playing Field Across Industry-Government with Common Environment
  - A program management environment to enable C2 Enterprise Integration and Interoperability